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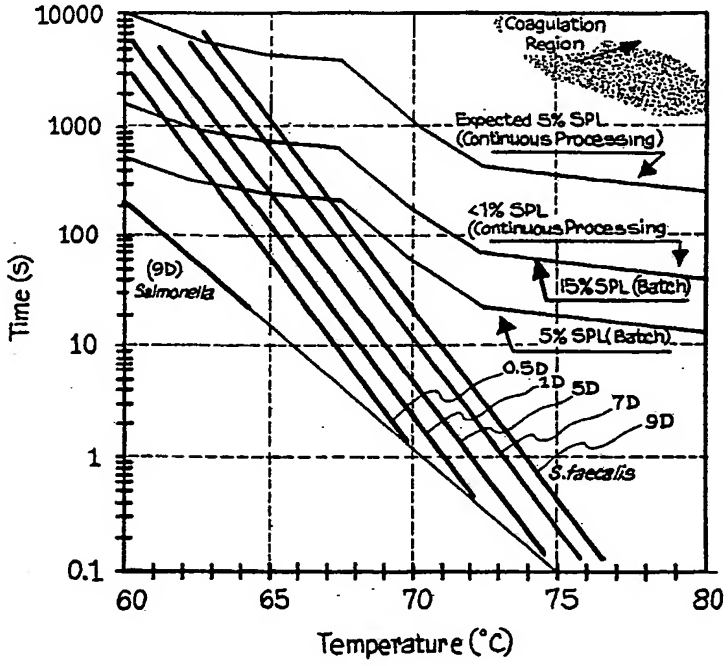
(54) Title: A PROCESS FOR THE PASTEURIZATION OF EGG PRODUCTS



(57) Abstract

A method of pasteurizing liquid egg products. The method comprises a heating step, followed by an irradiation step. The liquid egg product is irradiated with a dose of ionizing radiation insufficient of itself to pasteurize such a product.

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A Process For The Pasteurization Of Egg Products

Field of the Invention

This invention relates to the pasteurization of egg products generally, and particularly relates to pasteurization methods which employ both a heat treatment step and an irradiation step.

Background of the Invention

The U.S. egg industry produced more than 300 million pounds of frozen pasteurized egg products in 1985. The relatively mild pasteurization processes used are designed to eliminate Salmonella from eggs, but do not destroy organisms capable of spoiling egg products held under refrigerated temperatures above freezing. The survival of spoilage organisms in pasteurized egg, coupled with conventional packaging technology, results in products with limited shelf life (7-14 days at 40° F.) that require freezing and frozen distribution systems for preservation. Freezing is cost intensive, lowers the functional quality (flavor, performance, etc.) of the egg product, and results in an inconvenient product that requires thawing prior to use.

To produce a refrigerated liquid whole egg product, the product must be ultrapasteurized to reduce the population of spoilage bacteria, rather than merely pasteurized to reduce the population of Salmonella.

Pasteurization techniques are generally discussed in the Egg Pasteurization Manual, USDA Agricultural Research Service (1969) (hereinafter "the Manual"). Heat pasteurization methods for liquid whole egg products are discussed at pages 14 to 16 of the Manual, and radiation pasteurization methods are discussed at pages 20 to 21 of the Manual. Interest in irradiation processes for these products was stimulated because of the heat sensitivity of these products, and by the desire to develop a "cold" treatment for the products. However, because doses of ionizing radiation sufficient to pasteurize liquid egg products lead to undesirable flavor changes in the products, heat pasteurization has been the method of choice, and radiation pasteurization has been little used for liquid egg products. See also Recent Advances in Food Irradiation (P.S. Elias and A.J. Cohen, Eds. 1983); Combination Processes in Food Irradiation (International Atomic Energy Agency Vienna 1981)

Recent advances in heat ultrapasteurization procedures have enabled the production of relatively shelf-stable refrigerated liquid whole egg products. However, there is a continued need for techniques which can be used to provide products with still greater resistance to spoilage.

The object of the present invention is, accordingly, to provide a method which can be used to produce pasteurized and ultrapasteurized liquid egg products which have good functional properties.

Another object of the invention is to make use of available irradiation equipment, which has heretofore been considered of little use in the treatment of liquid egg products, in methods for pasteurizing and ultrapasteurizing liquid egg products, and which does not lead to undesirable flavor changes in the product.

Description of the Invention

The foregoing object is achieved by a method of ultrapasteurizing liquid egg products. The method comprises the steps of heating the liquid egg product to a predetermined temperature for a predetermined time, and then irradiating the product with a predetermined dose of ionizing radiation insufficient of itself to pasteurize such a liquid egg product. The predetermined time, predetermined temperature, and predetermined dose of ionizing radiation are selected to provide a combined treatment sufficient to at least pasteurize the liquid egg product. The term "pasteurize," as used herein, means to provide a nine log cycle (9D), or 99.9999999%, reduction in Salmonella bacteria.

This method is preferably used to ultrapasteurize a liquid egg product which has already been heat pasteurized: more particularly, where the liquid egg product has been heated to a temperature and for a time sufficient to pasteurize the product.

Any type of ionizing radiation, such as beta and gamma radiation, may be used to practice the present invention, with gamma rays being preferred. The precise dose of ionizing radiation will vary according to the particular egg product being treated. In general, doses less than about .4M rad are preferred, and doses less than about .2M rad are more preferred. As explained below, the egg product is preferably irradiated after it has been packaged. Commercial plants using cobalt-60 sources to administer gamma radiation are presently the most available and most economical sources of ionizing radiation for treating food products, see, e.g., Combination Processes in Food Irradiation, supra, at 413-20, but a number of known means for administering

ionizing radiation can be used for practicing the present invention.

While heat pasteurization may be carried out a number of ways, the liquid egg product is preferably heat pasteurized in a continuous flow system. In such a system the liquid egg product is passed as a continuous stream through a pasteurizing apparatus, during which the liquid egg product is heated to a predetermined real temperature. More particularly, the liquid egg product is heated to a predetermined holding temperature, then maintained at the predetermined holding temperature for a predetermined holding time, and then cooled. The liquid egg product is preferably packaged after pasteurization, but before irradiation. To obtain a product having reduced levels of spoilage microorganisms, the packaging step is preferably an aseptic packaging step. In addition, the pasteurizing apparatus is preferably sterilized with hot water, in accordance with known procedures, before the liquid whole egg product is passed therethrough.

The accompanying figure is provided to aid in designing thermal processes for heat pasteurization for use in conjunction with the present invention. In continuous flow equipment, the times and temperatures plotted on this graph should represent the equivalent time and temperature provided by the thermal treatments. Equivalent times and temperatures can be determined with the equivalent point method. Procedures for use of the equivalent point method for analyzing the thermal effects during continuous flow heating have been previously provided. (Swartzel, 1982, J. Food Sci. 47:1886 and Swartzel, 1986, J. Agric. Food Chem. 34:397).

Use of the equivalent point method is particularly desirable when the thermal treatment is an

ultrapasteurization procedure (a procedure designed to decrease the numbers of spoilage microorganisms in the product to levels lower than obtained with a pasteurization procedure.

Lines defining the approximate thermal treatments which provide a 0.5D, 1D, 5D, 7D and 9D reduction in the spoilage microorganism Streptococcus faecalis are plotted, as well as the line defining thermal treatments which provides a 9D reduction in Salmonella. Treatments which provide a greater reduction in spoilage microorganisms such as S. faecalis are preferred.

The thermal treatment should produce not more than a 5% soluble protein loss (SPL) in the product being pasteurized, and preferably not more than a 1% soluble protein loss. Previous work suggested that thermal treatments above the 5% SPL (Batch) line would not produce a functionally acceptable product. However, thermal treatments defined by points above this line can be used to produce an ultrapasteurized product having good functional properties. The figure is based on studies with liquid whole egg. Note commonly owned patent application Serial No. 904,744 of Swartzel et al., titled "Method for the Ultrapasteurization of Liquid Whole Egg Products," filed September 8, 1986. It is provided for its pertinence to this particular product, and for its usefulness to those skilled in the art for designing thermal treatments for other liquid egg products. Liquid egg products which can be pasteurized by the method of the present invention include, for example, liquid egg whites, liquid plain yolk, liquid sugar yolk, liquid salt yolk, and numerous liquid whole egg products. Liquid whole egg products include, for example, whole egg, fortified whole egg (whole egg with added yolk), salt whole egg (e.g., salt 10%), sugar

whole egg (e.g., sugar 10%), blends of whole egg with corn syrup solids, syrups, dextrose and dextrins and/or gums and thickening agents, blends of whole eggs with less than 1% sugar and/or salt, scrambled egg mixes (for example, a mix of about 51% egg solids, 30% skim milk solids, 15% vegetable oil and 1.5% salt), reduced cholesterol egg products and blends thereof, custard blends, and the like.

The invention has been discussed with a degree of specificity above. This discussion has been provided for illustrative purposes only, with the scope of the invention being defined by the following claims.

THAT WHICH IS CLAIMED IS:

1. A method of pasteurizing a liquid egg product, comprising the steps of

(a) heating the said liquid egg product to a predetermined temperature for a predetermined time, and then

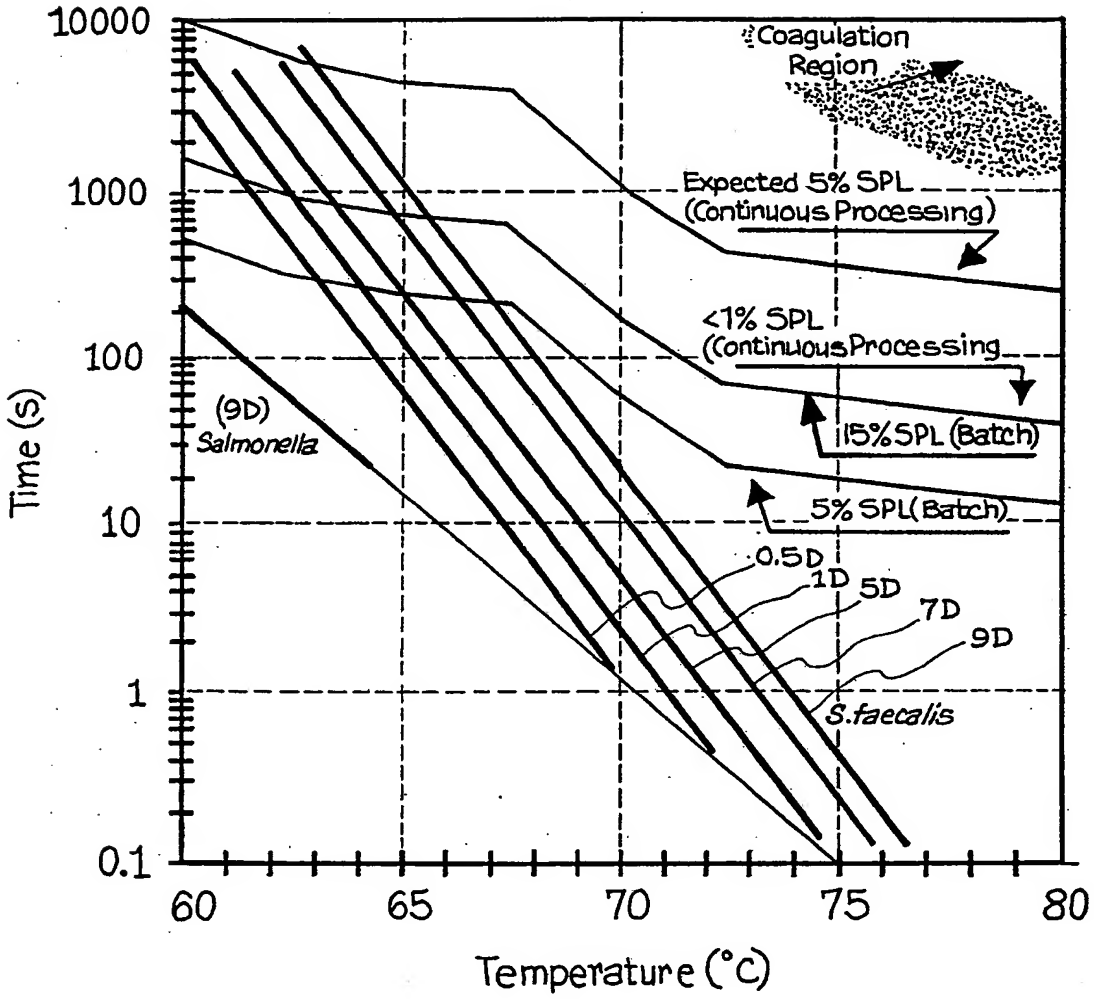
(b) irradiating the product with a predetermined dose of ionizing radiation insufficient to cause a nine log cycle reduction of Salmonella bacteria in said liquid egg product,

wherein said heating step and said irradiating step together cause at least nine log cycle reduction of Salmonella bacteria in the said liquid egg product.

2. A method according to Claim 1, wherein said liquid egg product is heated to a temperature and for a time during said heating step sufficient to cause a nine log cycle reduction in Salmonella bacteria in said liquid egg product.

3. A method according to Claim 1, wherein said liquid egg product is packaged after heating the product and before irradiating the product.

4. A method according to Claim 1, wherein said irradiating step is carried out by exposing the liquid egg product to gamma radiation.


10000
1000
100
10
1
0.1
Time (s)
60
65
70
75
80
Temperature (°C)
Coagulation Region
Expected 5% SPL (Continuous Processing)
<1% SPL (Continuous Processing
15% SPL (Batch)
5% SPL (Batch)
(9D) Salmonella
0.5D
1D
5D
7D
9D
S.faecalis

INTERNATIONAL SEARCH REPORT

International Application No PCT/US87/02280

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (4): A 23 B 5/00
U.S. CL.: 426/240, 521

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	426/240, 521

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [6]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	M.H-SAMIMI ET AL, "ASEPTIC PROCESSING AND PACKAGING OF FOOD," PROCEEDING FROM AN IUFOST SYMPOSIUM ON 9-12 SEPTEMBER 1985, IN TYLOSAND SWEDEN. SEE PAGES 229-235	1-4
Y	M.H-SAMIMI ET AL, "PASTEURIZATION DESIGN CRITERIA FOR PRODUCTION OF EXTENDED SHELF-LIFE LIQUID WHOLE PRODUCT" ISSUED ON FEBRUARY 1985, SEE THE ENTIRE DOCUMENT.	1,2
A	EP, A, 0,122,383 (SOC PROD NESTLE) 24 OCTOBER 1984 SEE THE ENTIRE DOCUMENT	1-4
Y	E. ADEM . ET AL, "RADIATION STERILIZATION OF ORANGE JUICE, "PUBLISHED 22 JULY 1969, SEE LINES 25 TO 30, PAGE 2	1
A	EGG PASTEURIZATION MANUAL ARS 74-48; ISSUED FEBRUARY 1969 BY DEPARTMENT OF AGRICULTURE (CALIFORNIA) SEE THE ENTIRE DOCUMENT	1-4

* Special categories of cited documents: [15]

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
27 November 1987	12 JAN 1988
International Searching Authority [1]	**Signature of Authorized Officer** [20]
ISA/US	Virginia Manoharan

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category*	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US, A, 3,404,008 (BALLAS ET AL) 01 OCTOBER 1968, SEE THE ENTIRE DOCUMENT	1-4
A	CA, A, 717,935 (KUHL ET AL) 14 SEPTEMBER 1965, SEE LINES 12 TO 24, PAGE 1, AND LINES 14 TO 18, PAGE 5	1, 3, 4
X	GB, A, 880,456 (VIDAL) 25 OCTOBER 1961 SEE LINES 44 TO 84, PAGE 1	1-4
Y	US, A, 2,806,797 (BRASCH ET AL) 17 SEPTEMBER 1957 SEE COLUMN 3, LINES 2 TO 16	1,4